

**B. Data Collection**

- Define an observation period.
- Define an observation site and what procedures were implemented when the observation site was not accessible on the date assigned.
- Describe what vehicles were observed and what procedures were implemented when traffic was too heavy to observe all vehicles.
- Describe the data recording procedures.

**C. Estimation:**

- Display the raw data and the weighted estimates.
- For each estimate, provide an estimate of one standard error and an approximate 95 percent confidence interval.
- Describe how estimates were calculated and how variances were calculated.

Issued on: March 19, 1992.

Michael B. Brownlee,  
Associate Administrator, Traffic Safety  
Programs.

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# **Office of Commercial Space Transportation**

[Notice 92-4]

## **Commercial Space Transportation; Evaluation Criteria for Issuance of Vehicle Safety Approval for the COMET Reentry Vehicle System**

**AGENCY:** Office of the Secretary, Office  
of Commercial Space Transportation,  
DOT.

**ACTION:** Notice.

**SUMMARY:** Pursuant to the Commercial Space Launch Act of 1984, as amended, and the Commercial Space Transportation Licensing Regulations (the regulations), the Department of Transportation (the Department) is evaluating a proposed commercial reentry vehicle system in order to determine whether a vehicle safety approval may be issued. The Department is undertaking this evaluation as part of the first application for a launch license to conduct commercial reentry operations. The purpose of this Notice is to describe the Department's approach to assessing the safety and reliability of the reentry vehicle system, as part of the Safety Review required under the regulations to support a licensing determination.

**FOR FURTHER INFORMATION CONTACT:**  
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### **SUPPLEMENTARY INFORMATION:**

#### **Background**

Under the Commercial Space Launch Act of 1984, as amended, 49 U.S.C. app. 2601-2623 (the Act), the Department of Transportation (the Department) is authorized to license and otherwise regulate commercial space launch activities. In carrying out the Department's regulatory authority, the Secretary of Transportation is responsible for facilitating and promoting commercial space launches and protecting the public health and safety, safety of property, and national security and foreign policy interests of the United States (49 U.S.C. app. 2601). The Department exercises this authority through the Office of Commercial Space Transportation (OCST or the Office).

#### **OCST's Licensing Process**

Under the Commercial Space Transportation Licensing Regulations (the regulations) promulgated pursuant to the Act (49 CFR chapter III), a prospective launch licensee's proposal must undergo a Mission Review and Safety Review, and be granted an approval for each. Mission Review is "the procedure for identifying significant issues affecting United States national interests and international obligations that may be associated with a proposed launch" and includes the payload to be launched (49 CFR 415.21). Safety Review is "the procedure for determining whether an applicant can safely conduct the preparation and launch of the proposed launch vehicle and any payload." (49 CFR 415.11) Mission and safety approval determinations are incorporated into and made part of the licensing record.

The Safety Review process focuses on an applicant's safety operations generally. Included in the review process, among other things, are the proposed launch site; user and range operator procedures for control of pre-launch and launch hazards to the public; trajectory flight safety analysis; and safe flight operations; personnel qualifications; and equipment, instrumentation, and vehicle safety systems (49 CFR 415.11). The burden is on the applicant to demonstrate that it fully understands the public safety hazards associated with its proposed launch activity and that its procedures, personnel, and equipment are adequate and appropriate to support safe operations.

The Office approaches license applications on a case-by-case basis in evaluating proposed launch activities under the Office's licensing authority. Under this approach, any public safety-related issues must be reviewed and evaluated to determine whether the launch can be conducted safely by the applicant. Thus, the Office retains the flexibility necessary to accommodate the various launch proposals presented for licensing while carrying out its mandate of assuring that any matters that may affect public safety are adequately addressed.

#### **The COMET Program**

Through the Commercial Experiment Transporter or COMET Program, Space Industries, Inc. (Space Industries) and Westinghouse Electric Corporation (Westinghouse) are each under contract with the Centers for the Commercial Development of Space (CCDS) to provide the services of a reentry vehicle system to carry and return to earth experimental payloads.<sup>1</sup> Presently, the COMET Program calls for three reentry missions with a possibility of two more.

The reentry vehicle system, known as the FreeFlyer, is comprised of a service module, manufactured by Westinghouse, and a reentry vehicle, manufactured by Space Industries. Operation of both components of the reentry vehicle system has a potentially significant impact on public safety.

Under another contract between the CCDS and a commercial launch operator, the FreeFlyer will be launched to low earth orbit using a Conestoga launch vehicle. The launch will be separately licensed by the Office and will be conducted from Wallops Flight Facility, Virginia. After delivery on orbit, the FreeFlyer will be operated by Space Industries.

The FreeFlyer will remain in low earth orbit for a period of approximately 30 days to permit the conduct of long duration microgravity experiments. At the end of this period, and upon command from Space Industries' ground personnel, the reentry vehicle will separate from the service module. Once the reentry vehicle has separated and moved away from the service module, a propulsion system built into the reentry vehicle will be activated and the reentry vehicle will be launched on a suborbital trajectory for its return to earth. At present, the designated landing site for

<sup>1</sup> The CCDS, which promote commercial space research in the private sector, are sponsored jointly by the National Aeronautics and Space Administration's (NASA) Office of Commercial Programs, the academic community, industry, and other state and federal government agencies.

the reentry vehicle is the Utah Test and Training Range, a U.S. Government facility located in a sparsely populated area of Utah.<sup>3</sup> The service module is not designed to reenter with the reentry vehicle and will remain operational for approximately 100 days or more on orbit continuing to support microgravity experiments. Subject to any control exercised by the operator, Space Industries, the service module's orbit will eventually decay to a point where it will reenter the earth's atmosphere and burn up during reentry.

#### *COMET Reentry Vehicle Safety Approval*

The launch of a reentry vehicle initiating its return to earth is a suborbital launch subject to the Department's licensing authority. In launches from earth to space utilizing unmanned expendable launch vehicle (ELV) systems, launch safety is typically provided by range safety personnel monitoring the launch, as well as safety systems, such as flight termination systems, built into the vehicle.<sup>4</sup> Because these safety systems are intended to assure that the public will not be exposed to hazards resulting from a launch, there has been no need for the Office to assess independently vehicle design, manufacture, and performance. In contrast to most of the commercial launches licensed to date, the COMET reentry vehicle system, or FreeFlyer, will not rely upon a flight termination system as a primary mechanism for protecting public safety because destruction of the vehicle during reentry, possibly over populated areas, could present safety hazards. Accordingly, the reliability and performance of the reentry vehicle system are highly significant from a public safety perspective.

As part of the licensing Safety Review process described above, Space Industries has applied for vehicle safety approval of the FreeFlyer. The vehicle safety review process is intended to assess the safety of the reentry vehicle system when operated in accordance with certain operating limits. Accordingly, the review encompasses the vehicle's design, engineering analyses, testing, manufacture, and

maintenance. The Office commenced the vehicle safety review process during the initial design stage of the reentry vehicle system and will continue the process through the vehicle's operational development.

Vehicle safety approval will be subject to, among other things, demonstration by Space Industries that the integrated reentry vehicle system can be operated safely and reliably. Absent this demonstration, the FreeFlyer will not be approved by the Office. Subject to OCST approval, Space Industries may select the methodology it will use, as part of its vehicle safety demonstration, to identify and address potential hazards and risks to public safety posed by the reentry vehicle system and associated operating system components. As the applicant for vehicle safety approval, Space Industries must address, among other things, engineering and safety analyses, component system tests and checkouts, quality assurance procedures, manufacturing processes, and test plans and results. It must also demonstrate the adequacy and validity of the methodological approaches selected for each of the foregoing as part of its demonstration of the safe operating limits of the reentry vehicle system.

The vehicle safety approval, if issued by the Office, will be limited to the precise design and operating limits presented by Space Industries in its application and considered by the Office in making its determination. Thus, following issuance of the vehicle safety approval and prior to launch, any change proposed by Space Industries in the operation, design or construction of any part of the reentry vehicle system or any of its safety systems must be presented to the Office and is subject to risk analysis, hazard identification, evaluation, and approval. The vehicle safety approval would then be reissued to reflect the approved changes. In addition, the Office may impose conditions on the vehicle safety approval as necessary to protect public safety. The Office's determination will become part of the record used to support the licensing action (49 CFR 415.7, 415.15, and 415.17).<sup>5</sup>

<sup>4</sup> As noted above, the COMET Program consists of three reentry missions with a possibility of two additional missions. Because the vehicle safety approval for the FreeFlyer would be issued by the Office as part of a specific launch licensing determination on a case-by-case basis, it would be granted subject to review and reissuance by the Office in authorizing each COMET reentry mission. The Office will consider all available data in determining whether the vehicle safety approval may be reissued, including the vehicle's performance and whether Space Industries' demonstration of safety and reliability has been

The Office will also conduct an independent evaluation of the reliability and design performance of the reentry vehicle system as they relate to public safety, based upon design information provided by Space Industries. This independent evaluation serves several purposes, including: (1) Providing a means of ensuring that all risks and hazards have been identified by the applicant, Space Industries, and adequately addressed; and (2) providing technical verification of the applicant's analysis of the reliability of the reentry vehicle system.

Under its contract with the CCDS, Space Industries is responsible for obtaining authorization from DOT to launch the reentry vehicle for its return to the designated landing site on earth. Upon receipt of a completed license application from Space Industries, the Office will conduct the licensing Safety and Mission Reviews required under the regulations. Space Industries, as the launch license applicant, will be required to demonstrate, among other things, that it is capable of operating the system safely. Such safety issues as orbital safety will also be addressed during the licensing Safety Review. Because the Office's vehicle safety approval determination is part of the record on which the licensing Safety Review is conducted, absent any changes to the reentry vehicle system, the vehicle safety approval need not be reconsidered.

#### *Vehicle Safety Approval Criteria*

In order to obtain a vehicle safety approval from the Office, an applicant must demonstrate that its vehicle can be operated safely. In fulfilling its statutory mandate to protect public safety, the Office has selected three criteria against which the integrated COMET reentry vehicle system, or FreeFlyer, will be evaluated prior to issuing a vehicle safety approval.

The criteria are designed to assess the capability of the COMET reentry vehicle system as it relates to public safety. As noted above, a separate review of the operation of the reentry vehicle system, including safety policies, procedures, personnel, and other equipment, will be conducted upon submission by Space Industries of a completed launch license application.

validated by actual flight data. Additionally, following the first COMET mission, any proposed changes to the reentry vehicle system, such as a difference in design or operating characteristics, would be subject to the vehicle safety approval process and may warrant the imposition of additional conditions.

<sup>3</sup> On August 22, 1991, OCST published in the Federal Register a notice of its intent to prepare a programmatic environmental impact statement (EIS) for commercial reentry vehicle programs, and invited public comment (56 FR 41718). In addition, OCST will be involved in developing a site-specific environmental assessment of the COMET reentry vehicle launches.

<sup>5</sup> Until COMET, all license applications submitted to the Office have sought authorization to conduct the launch of an ELV from earth to space.

The evaluation criteria are performance-based, rather than design standards, because the Office believes that performance-based criteria allow the maximum flexibility in developing a safe and cost-effective product. The Office further believes that performance-based criteria enhance the public interest by encouraging innovation and technology development. This environment promotes safe space transportation services at lower cost and helps assure that customers' needs are addressed.

The three criteria applicable to the COMET reentry vehicle system, all of which must be satisfied, are as follows:

1. The probability of the reentry vehicle landing outside the designated landing site shall not be greater than three in one thousand missions.

2. The additional risks to the public in the immediate vicinity of the landing site (i.e., the area within 100 miles of the designated landing site) shall not exceed the normal background risks to which those individuals would ordinarily be exposed but for the reentry missions. This normal background risk is characterized as: the probability of any casualty occurring within the 100-mile zone shall not exceed one in a million on an annual basis. In addition, the probability of any casualty occurring within the zone shall not exceed one in a million for a single mission.

3. The additional risks to the general public beyond the 100-mile zone around the designated landing site, and to property on orbit, shall not exceed normal background risks to which the public would ordinarily be exposed but for the reentry missions. This normal background risk is characterized as: The probability of any casualty occurring shall not exceed one in a million on an annual basis. In addition, the probability of any casualty occurring in the area that is both outside of the designated landing site and the 100-mile zone around the site shall not exceed one in a million for a single mission.

Supporting rationale for the criteria and thresholds selected.

The criteria selected acknowledge that some hazards, and therefore risks, accompany the proposed reentry activity. The criteria reflect those hazards reduced to acceptable levels of risk. Accordingly, the three criteria correspond to the following separate, but interrelated safety objectives:

1. Assuring that reentry vehicles land within the designated landing site. The Office believes that public acceptance of commercial space transportation depends upon the reliable, accurate and incident-free conduct of such activities.

By requiring that all landings of the reentry vehicle be incident-free, the Office intends that there be no unplanned landing outside of the designated area that could affect public safety. Criterion 1 is thus intended to ensure that virtually all landings occur within a controlled area, the designated landing site, where safety measures are in place and public exposure greatly minimized.

The threshold value of Criterion 1, a three in 1,000 probability of an off-site landing, is based upon the three-sigma dispersion standard commonly used by government and industry for comparably or similarly hazardous activities. The Office has selected this value as a means of ensuring the precision of reentry accuracy.

Criterion 1 assumes nominal pre-launch conditions and addresses factors that affect the accuracy of the vehicle after the command to initiate reentry is issued. Such factors include, but are not limited to, weather and atmospheric density, design tolerances of components related to reentry, and undetected system failures as of initiation of reentry. Abnormal circumstances, such as a system failure, which prevent or preclude the reentry vehicle from operating as intended are accounted for under Criterion 3.

2. Limiting risks to the public within close proximity of the designated landing site. Certain individuals, such as those living immediately adjacent or in close proximity to the designated landing site, are likely to have greater concerns about the proposed reentry activities and believe they hold a greater stake in the safe conduct of such activities than the general public. The Office believes that these concerns should be addressed directly by the evaluation criteria in order to promote the confidence of that segment of the population that is potentially most affected by reentry activities. Criterion 2 reflects the Office's view that the risks to this population segment should not exceed the level of background risks to which they are ordinarily exposed in daily life. In other words, those people living closest to the designated landing site should not be exposed to significant additional risks as a result of the conduct of reentry activities. This criterion would become most relevant in the event of a system error or failure that causes a deviation from the vehicle's planned trajectory.

The Office has compared the risk threshold established under Criterion 2—the probability of a casualty occurring within a 100-mile radius of the landing site shall not be greater than

one in a million on an annual basis and for any single mission—to the risks individuals confront daily or when performing routine activities and determined that the threshold value for Criterion 2 is sufficiently conservative to ensure that the risks to the public residing in the vicinity of the designated landing site as a result of reentry activities are not greater than and are comparable to their usual background risks.

3. Limiting risks to all persons, wherever situated, arising from commercial reentry launch activities. The threshold value of Criterion 3 is equivalent to that of Criterion 2. The Office believes that the general public should not be exposed to significant additional risks as a result of the conduct of commercial reentry activities. Criterion 3 is intended to ensure this result.

Under Criterion 3, the level of risk presented by commercial reentry activities should not exceed the level of background risks to which the public is ordinarily exposed. Thus, the same background risk rationale employed by the Office in selecting the Criterion 2 threshold value is equally applicable to Criterion 3. The two populations are addressed separately by the evaluation criteria because the risks to the public residing within 100 miles of the designated landing site would most likely be attributable to a system error or failure that affects the accuracy of the reentry vehicle. Risks to the general public would be attributable to a major system failure such that the landing site for the reentry vehicle is essentially random. Accordingly, the potential hazards to the two populations must be analyzed separately.

The criteria selected by the Office for evaluating the COMET reentry vehicle system are intended to result in the same level of public safety, regardless of the number of missions conducted under the COMET Program. Thus, the evaluation criteria, which address risk probability on both an annualized and per mission basis, become more stringent as the frequency of COMET missions increases. Under these evaluation criteria, the risks to the public cannot increase as the number of reentry missions conducted increases. Accordingly, the Office believes the three evaluation criteria presented herein are appropriate for evaluating the COMET reentry vehicle system from a public safety standpoint.

Issued in Washington, DC, this 17th day of March, 1992.

Stephanie E. Myers,

*Director, Office of Commercial Space Transportation.*

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**EFFECTIVE DATE:** This notice is effective March 24, 1992.

**FOR FURTHER INFORMATION CONTACT:**

Mr. Leonard A. Levy, Assistant Director for Loan Management (261), Loan Guaranty Service, Veterans Benefits Administration, Department of Veterans Affairs, 810 Vermont Avenue, NW., Washington, DC 20420. (202) 233-3668.

administration and resale. Each year VA reviews the average operating expenses incurred for properties acquired under 38 CFR 36.4320 which were sold during the preceding three fiscal years and the average administrative cost to the government associated with the property management activity. VA annually updates the "net value" and publishes a notice of the





